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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/998,858	10/31/2001	Wen-Ben Chou	LAM2P295	6935

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EXAMINER	
CHEN, KIN CHAN	

ART UNIT	PAPER NUMBER
1765	

DATE MAILED: 04/01/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)
	09/998,858	CHOU ET AL.
	Examiner	Art Unit
	Kin-Chan Chen	1765

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *13 February 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,3-16 and 21-25* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,3-16 and 21-25* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on February 13, 2004 has been entered.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 1, 3-16 and 21-25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nguyen et al. (US 6,207,544; hereinafter "Nguyen") in view of Chiu et al. (US 6,333,27; hereinafter "Chiu") and Armacost et al. (US 6,051,504; hereinafter "Armacost").

Nguyen teaches a method for fabricating a nitride spacer of a gate structure. A first etch process may be performed using a first etchant gas. The first etch process may be discontinued upon removing the portion of the spacer layer, leaving a thin spacer layer. The endpoint detection method may be used to detect a removal of a portion of a spacer layer having a specific thickness. A second etch process may be performed using a second etchant gas. The second etch process may be configured to remove the thin spacer layer. The second etch process may be discontinued when the second etch process has continued for a predetermined period time. The etching may be performed in-situ. The second etch process is configured to remove the thin spacer layer, leaving the spacer for the gate structure (col. 5, lines 10-17, col. 6, lines 28-40). Nguyen teaches that the endpoint of etching may be determined **using traditional optical spectrometers** (col. 6, lines 10-12). The claimed invention differs from Nguyen by specifying using interferometry for first etch endpoint detection (e.g., claims 1, 6, and 7) and using non-interferometry for second etch endpoint detection. However, they are common methods for endpoint detection in dry etching process. In a method of multi-step plasma etch method, Chiu teaches using first plasma etch method and using first detection apparatus (such as interfermetry) to partially etch a microelectronic layer and employing second plasma etch employing a second detection apparatus (such as plasma / optical emission spectroscopy, so-called non-IEP) in order to accurately determine the endpoint of plasma etching, measure /control the thickness (abstract, col. 2, lines 44-66; col. 12, lines 23-28). Hence, it would have been obvious to one with ordinary skilled in the art to use said two-step etching and endpoint detection of Chiu in

the process of Nguyen because Chiu teaches that to do so would accurately determine the endpoint of plasma etching, measure /control the thickness. Furthermore, it would have been obvious to one with ordinary skilled in the art to use commonly used endpoint detection methods in the plasma etching process when required, see Maydan et al. (US 4,618,262) and Gardner et al. (US 5,912,188) as evidences in the record for the commonly used interferometry and non-interferometry (non IEP) methods for etching endpoint detection. Nguyen teaches that the etching selectivity may be 2:1 when performing a second etch process which shows higher etching rate for nitride layer (spacer layer) than the underlying layer, hence, **it is considered to have a high selectivity.** If applicant contends that the etchant does not have high selectivity, Armacost teaches that the etchant of C_2F_6, CH_2F_2, and O_2 may be used to etch silicon nitride layer from a multiplayer structure in order to etch high aspect ratio silicon nitride and avoid loss of image integrity (abstract; col. 2). Hence, it would have been obvious to one with ordinary skilled in the art to use the etchant of Armacost in the process of the combined prior art so as to etch high aspect ratio silicon nitride and avoid loss of image integrity. In addition, the disclosed etching composition is considered to have the same etching properties (e.g., high selectivity) because they are the same composition defined in the applicant's claims.

The limitations of dependent claims 4, 5, 8, 10,11, 15, and 16 have been addressed above and rejected for the same reasons, supra.

As to dependent claims 3 and 9, with the interferometry method, It would have been obvious to one with ordinary skilled in the art to determine the thickness of an etch

depth during the etch operation implementing the distance between consecutive maximum intensities.

Dependant claims 12, 13, and 14 differ from the prior art by specifying various thickness of the spacer. Because same are merely a matter of choices of design depending on the product requirements, it would be obvious to one skilled in the art to use various dimensions for fabricating a semiconductor device in order to accommodate the specific product design and meet the product requirement. It is noted that applicant did not traverse the aforementioned conventionality (e.g., well-known features, obviousness), which have been stated in the previous office action (October 8, 2003).

4. Claims 1, 3-16, 21-25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yu et al. (US 6,277,700; hereinafter "Yu") in view of Chiu et al. (US 6,333,27; hereinafter "Chiu") and Armacost et al. (US 6,051,504; hereinafter "Armacost").

Yu teaches a method for fabricating a nitride spacer of a gate structure. A first etch process may be performed using a first etchant gas. The first etch process may be discontinued upon removing the portion of the spacer layer, leaving a thin spacer layer. The endpoint detection method may be used to detect a removal of a portion of a spacer layer having a specific thickness. A second etch process may be performed using a second etchant gas. The second etch process may be configured to remove the thin spacer layer. The second etch process may be discontinued when the second etch process has continued for a predetermined period time. The etching may be performed

in-situ. The second etch process is configured to remove the thin spacer layer, leaving the spacer for the gate structure (col.1, lines 64 through col. 2, lines 60).

Yu teaches that the endpoint of etching may be determined with endpoint detection (col. 2, lines 58-59). The claimed invention differs from Yu by specifying using interferometry for first etch endpoint detection (e.g., claims 1, 6, and 7) and using non-interferometry for second etch endpoint detection. However, they are common methods for endpoint detection in dry etching process. In a method of multi-step plasma etch method, Chiu teaches using first plasma etch method and using first detection apparatus (such as interfermetry) to partially etch a microelectronic layer and employing second plasma etch employing a second detection apparatus (such as plasma / optical emission spectroscopy, so-called non-IEP) in order to accurately determine the endpoint of plasma etching, measure / control the thickness (abstract, col. 2, lines 44-66; col. 12, lines 23-28). Hence, it would have been obvious to one with ordinary skilled in the art to use said two-step etching and endpoint detection of Chiu in the process of Yu because Chiu teaches that to do so would accurately determine the endpoint of plasma etching, measure / control the thickness. Furthermore, it would have been obvious to one with ordinary skilled in the art to use commonly used endpoint detection methods in the plasma etching process when required, see Maydan et al. (US 4,618,262) and Gardner et al. (US 5,912,188) as evidences in the record for the commonly used interferometry and non-interferometry methods for etching endpoint detection. Nguyen teaches that the etching selectivity may be 2:1 when performing a second etch process which shows higher etching rate for nitride layer (spacer layer)

than the underlying layer, hence, **it is considered to have a high selectivity.** If applicant contends that the etchant does not have high selectivity, Armacost teaches that the etchant of C_2F_6, CH_2F_2, and O_2 may be used to etch silicon nitride layer from a multiplayer structure in order to etch high aspect ratio silicon nitride and avoid loss of image integrity (abstract; col. 2). Hence, it would have been obvious to one with ordinary skilled in the art to use the etchant of Armacost in the process of the combined prior art so as to etch high aspect ratio silicon nitride and avoid loss of image integrity. In addition, the disclosed etching composition is considered to have the same etching properties (e.g., high selectivity) because they are the same composition defined in the applicant's claims.

As to dependent claims 3 and 9, with the interferometry method, It would have been obvious to one with ordinary skilled in the art to determine the thickness of an etch depth during the etch operation implementing the distance between consecutive maximum intensities.

The limitations of dependent claims 4, 5, 8, 10,11, 15, and 16 have been addressed above and rejected for the same reasons, supra.

Dependant claims 12, 13, and 14 differ from the prior art by specifying various thickness of the spacer. Because same are merely a matter of choices of design depending on the product requirements, it would be obvious to one skilled in the art to use various dimensions for fabricating a semiconductor device in order to accommodate the specific product design and meet the product requirement. It is noted that applicant

did not traverse the aforementioned conventionality (e.g., well-known features, obviousness), which have been stated in the previous office action (October 8, 2003).

Response to Arguments

5. Applicant has argued that the second etchant gas of Nguyen has a low selectivityto the underlying layer. It is not persuasive. In fact, Nguyen teaches that the etching selectivity may be 2:1 when performing a second etch process which shows higher etching rate for nitride layer (spacer layer) than the underlying layer, hence, **it is considered to have a high selectivity. Furthermore,** Armacost teaches that the etchant of C_2F_6, CH_2F_2, and O_2 may be used to etch silicon nitride layer from a multiplayer structure. The disclosed etching composition is considered to have the same etching properties (e.g., high selectivity) because they are the same composition defined in the applicant's claims. In fact, It is noted that the first and second etchant in the claimed invention **seem to be same etchant (e.g.,** C_2F_6, CH_2F_2, and O_2).

Applicant has argued that the combined prior art does not teach discontinue the etch process after a predetermined period of time. It is not persuasive. In fact, the instant claims set forth "discontinuing the second etch process in response to the monitoring". Besides, when each etch process takes place, it **inherently** continues for a predetermined period of time, then stops.

Applicant has argued that Nguyen uses OES endpoint detection method first etch process. In response, as has been stated in the office action, Chiu teaches using first

plasma etch method and using first detection apparatus (such as interferometry) to partially etch a microelectronic layer and employing second plasma etch employing a second detection apparatus (such as plasma / optical emission spectroscopy, so-called non-interferometry).

One cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. In re Merk &Co., Inc., 800F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

Conclusion

6. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Maydan et al. (US 4,618,262) teach the commonly used interferometry method for etching endpoint detection. Gardner et al. (US 5,912,188) show that four common methods for determining the endpoint of dry etching process including interferometry and optical emission spectroscopy (col. 2, lines 9-16). Rutzke (US 6,122,050) teaches that plasma –optical emission spectrometer is a species of plasma spectrometer (col. 1, lines 35-58).

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Kin-Chan Chen whose telephone number is (571) 272-1461. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on (571) 272-1465. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

March 15, 2004

K. C. Chen

Kin-Chan Chen
Primary Examiner
Art Unit 1765

K-C C